## JEE Main 2024 Mock Test 4

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.


## Important Instructions:

1. The test is of 3 hours duration.
2. This test paper consists of 90 questions. Each subject (PCM) has 30 questions. The maximum marks are 300.
3. This question paper contains Three Parts. Part-A is Physics, Part-B is Chemistry and Part-C is Mathematics. Each part has only two sections: Section-A and Section-B.
4. Section - A : Attempt all questions.
5. Section - B : Do any 5 questions out of 10 Questions.
6. Section-A (01-20) contains 20 multiple choice questions which have only one correct answer. Each question carries $\mathbf{+ 4}$ marks for correct answer and $\mathbf{- 1}$ mark for wrong answer.
7. Section-B (1 - 10) contains 10 Numerical based questions. The answer to each question is rounded off to the nearest integer value. Each question carries $\mathbf{+ 4}$ marks for correct answer and -1 mark for wrong answer.

## PART - A (PHYSICS)

## SECTION - A

## (One Options Correct Type)

This section contains 20 multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE option is correct.

Q1. A person has been using spectacles of power -1.0 dioptre for distant vision and a separate reading glass of power 2.0 dioptres. What is the least distance of distinct vision for this person?
(A) 30 cm
(B) 40 cm
(C) 50 cm
(D) 10 cm

Q2. Two isolated metallic solid spheres of radii $R$ and $2 R$ are charged such that both have same charge density $\sigma$. The sphere are then connected by a conducting wire. If the new charge density of the bigger sphere is $\sigma^{\prime}$. The ratio $\frac{\sigma^{\prime}}{\sigma}$ is :
(A) $\frac{5}{3}$
(B) $\frac{5}{6}$
(C) $\frac{4}{3}$
(D) $\frac{9}{4}$

Q3. Match Column - I with Column - II :

| $\begin{gathered} \text { Column-I } \\ \text { (x-t graphs) } \end{gathered}$ |  | Column-II (v-t graphs) |  |
| :---: | :---: | :---: | :---: |
| A. |  | I. |  |
| B. |  | II. |  |
| C. |  | III. |  |



Choose the correct answer from the options given below :
(A) $\mathrm{A}-\mathrm{I}, \mathrm{B}-\mathrm{III}, \mathrm{C}-\mathrm{IV}, \mathrm{D}-\mathrm{II}$
(B) A - II, B - IV, C - III, D - I
(C) $\mathrm{A}-\mathrm{I}, \mathrm{B}-\mathrm{II}, \mathrm{C}-\mathrm{III}, \mathrm{D}-\mathrm{IV}$
(D) A - II, B - III, C - IV, D - I

Q4. A small object at rest, absorbs a light pulse of power 20 mW and duration 300 ns . Assuming speed of light as $3 \times 10^{8} \mathrm{~m} / \mathrm{s}$, the momentum of the object becomes equal to :
(A) $0.5 \times 10^{-17} \mathrm{~kg} \mathrm{~m} / \mathrm{s}$
(B) $3 \times 10^{-17} \mathrm{~kg} \mathrm{~m} / \mathrm{s}$
(C) $1 \times 10^{-17} \mathrm{~kg} \mathrm{~m} / \mathrm{s}$
(D) $2 \times 10^{-17} \mathrm{~kg} \mathrm{~m} / \mathrm{s}$.

Q5. In a series $L R$ circuit with $X_{L}=R$, power factor is $P_{1}$. If a capacitor of capacitance $C$ with $X_{C}=X_{L}$ is added to the circuit the power factor becomes $P_{2}$. The ratio of $P_{1}$ to $P_{2}$ will be :
(A) $1: \sqrt{2}$
(B) $1: 1$
(C) $1: 2$
(D) $1: 3$

Q6. The output waveform of the given logical circuit for the following inputs $A$ and $B$ is shown below, is :

(A)



Q7. The magnetic moments associated with two closely wound circular coils $A$ and $B$ of radius $r_{A}=$ 10 cm and $r_{B}=20 \mathrm{~cm}$ respectively are equal if : (Where $N_{A}, I_{A}$ and $N_{B}, I_{B}$ are number of turn and current of $A$ and $B$ respectively)
(A) $2 \mathrm{~N}_{\mathrm{A}} \mathrm{I}_{\mathrm{A}}=\mathrm{N}_{\mathrm{B}} \mathrm{I}_{\mathrm{B}}$
(B) $\mathrm{N}_{\mathrm{A}}=2 \mathrm{~N}_{\mathrm{B}}$
(C) $N_{A} I_{A}=4 N_{B} I_{B}$
(D) $4 N_{A} I_{A}=N_{B} I_{B}$

Q8. A massless square loop, of wire of resistance $10 \Omega$, supporting a mass of 1 g , hangs vertically with one of its sides in a uniform magnetic field of $10^{3} \mathrm{G}$, directed outward in the shaded region. A dc voltage V is applied to the loop. For what value of V , the magnetic force will exactly balance the weight of the supporting mass of 1 g ? (If sides of the loop $=10 \mathrm{~cm}, \mathrm{~g}=10 \mathrm{~ms}^{-2}$ )
(A) 10 V
(B) 100 V
(C) 1 V
(D) $\frac{1}{10} \mathrm{~V}$


Q9. The charge flowing in a conductor changes with time as $Q(t)=\alpha t-\beta t^{2}+\gamma t^{3}$. Where $\alpha, \beta$ and $\gamma$ are constants. Minimum value of current is :
(A) $\alpha-\frac{\beta^{2}}{3 \gamma}$
(B) $\alpha-\frac{3 \beta^{2}}{\gamma}$
(C) $\alpha-\frac{\gamma^{2}}{3 \beta}$
(D) $\beta-\frac{\alpha^{2}}{3 \gamma}$

Q10. As per the given figure, a small ball $P$ slides down the quadrant of a circle and hits the other ball $Q$ of equal mass which is initially at rest. Neglecting the effect of friction and assume the collision to be elastic, the velocity of ball $Q$ after collision will be : ( $\mathrm{g}=\mathrm{m} / \mathrm{s}^{2}$ )
(A) 0
(B) $0.25 \mathrm{~m} / \mathrm{s}$
(C) $4 \mathrm{~m} / \mathrm{s}$
(D) $2 \mathrm{~m} / \mathrm{s}$


Q11. A sinusoidal carrier voltage is amplitude modulated. The resultant amplitude modulated wave has maximum and minimum amplitude of 120 V and 80 V respectively. The amplitude of each sideband is :
(A) 15 V
(B) 5 V
(C) 20 V
(D) 10 V

Q12. Speed of an electron in Bohr's $7^{\text {th }}$ orbit for Hydrogen atom is $3.6 \times 10^{6} \mathrm{~m} / \mathrm{s}$. The corresponding speed of the electron in $3^{\text {rd }}$ orbit, in $\mathrm{m} / \mathrm{s}$ is :
(A) $\left(7.5 \times 10^{6}\right)$
(B) $\left(8.4 \times 10^{6}\right)$
(C) $\left(1.8 \times 10^{6}\right)$
(D) $\left(3.6 \times 10^{6}\right)$

Q13. The pressure $(\mathrm{P})$ and temperature $(\mathrm{T})$ relationship of an ideal gas obeys the equation $\mathrm{PT}^{2}=$ constant. The volume expansion coefficient of the gas will be :
(A) $\frac{3}{\mathrm{~T}^{2}}$
(B) $3 T^{2}$
(C) $\frac{3}{\mathrm{~T}}$
(D) $\frac{3}{\mathrm{~T}^{3}}$

Q14. Choose the correct relationship between poisson ratio $(\sigma)$, bulk modulus $(\mathrm{K})$ and modulus of rigidity $(\eta)$ of a given solid object :
(A) $\sigma=\frac{3 K-2 \eta}{6 K+2 \eta}$
(B) $\sigma=\frac{6 \mathrm{~K}-2 \eta}{3 \mathrm{~K}-2 \eta}$
(C) $\sigma=\frac{3 K+2 \eta}{6 K+2 \eta}$
(D) $\sigma=\frac{6 K+2 \eta}{3 K-2 \eta}$

Q15. If the gravitational field in the space is given as $\left(-\frac{K}{r^{2}}\right)$. Taking the reference point to be at $r=2 \mathrm{~cm}$ with gravitational potential $\mathrm{V}=10 \mathrm{~J} / \mathrm{kg}$. Find the gravitational potential at $\mathrm{r}=3 \mathrm{~cm}$ is SI unit (Given, that $\mathrm{K}=6 \mathrm{Jcm} / \mathrm{kg}$ )
(A) 9
(B) 12
(C) 10
(D) 11

Q16. Electric field in a certain region is given by $\vec{E}=\left(\frac{A}{x^{2}} \hat{i}+\frac{3}{y^{3}} \hat{j}\right)$. The SI unit of $A$ and $B$ are :
(A) $\mathrm{Nm}^{3} \mathrm{C} ; \mathrm{Nm}^{2} \mathrm{C}$
(B) $\mathrm{Nm}^{3} \mathrm{C}^{-1} ; \mathrm{Nm}^{2} \mathrm{C}^{-1}$
(C) $\mathrm{Nm}^{2} \mathrm{C}^{-1} ; \mathrm{Nm}^{3} \mathrm{C}^{-1}$
(D) $\mathrm{Nm}^{2} \mathrm{C} ; \mathrm{Nm}^{3} \mathrm{C}$

Q17. The height of liquid column raised in a capillary tube of certain radius when dipped in liquid $A$ vertically is, 5 cm . If the tube is dipped in a similar manner in another liquid $B$ of surface tension and density double the values of liquid $A$, the height of liquid column raised in liquid $B$ would be
$\qquad$
m.
(A) 0.20
(B) 0.5
(C) 0.05
(D) 0.10

Q18. The figure represents the momentum time (p-t) curve for a particle moving along an axis under the influence of the force. Identify the regions on the graph where the magnitude of the force is maximum and minimum respectively?
If $\left(t_{3}-t_{2}\right)<t_{1}$
(A) a and b
(B) b and c
(C) c and a
(D) c and b


Q19. A ball of mass 200 g rests on a vertical post of height 20 m . A bullet of mass 10 g , traveling in horizontal direction, hits the centre of the ball. After collision both travels independently. The ball hits the ground at a distance 30 m and the bullet at a distance of 120 m from the foot of the post. The value of initial velocity of the bullet will be (if $\mathrm{g}=10 \mathrm{~m} / \mathrm{s}^{2}$ ) :
(A) $120 \mathrm{~m} / \mathrm{s}$
(B) $60 \mathrm{~m} / \mathrm{s}$
(C) $400 \mathrm{~m} / \mathrm{s}$
(D) $360 \mathrm{~m} / \mathrm{s}$

Q20. Heat is given to an ideal gas in an isothermal process.
A. Internal energy of the gas will decrease.
B. Internal energy of the gas will increase.
C. Internal energy of the gas will not change.
D. The gas will do positive work.
E. The gas will do negative work.

Choose the correct answer from the options given below :
(A) A and E only
(B) C and D only
(C) C and E only
(D) B and D only

## SECTION - B

## (Numerical Answer Type)

This section contains 10 Numerical based questions. The answer to each question is rounded off to the nearest integer value.

Q1. As per the figure, if $\frac{d l}{d t}=-1 \mathrm{~A} / \mathrm{s}$ then the value of $\mathrm{V}_{\mathrm{AB}}$ at this instant will be $\qquad$ V.


Q2. In a screw gauge, there are 100 divisions on the circular scale and the main scale moves by 0.5 mm on a complete rotation of the circular scale. The zero of circular scale lies 6 divisions below the line of graduation when two studs are brought in contact with each other. When a wire is placed between the studs, 4 linear scale divisions are clearly visible while $46^{\text {th }}$ division the circular scale coincide with the reference line, The diameter of the wire is $\qquad$ $\times 10^{-2} \mathrm{~mm}$.

Q3. A horse rider covers half the distance with $5 \mathrm{~m} / \mathrm{s}$ speed. The remaining part of the distance was traveled with speed $10 \mathrm{~m} / \mathrm{s}$ for half the time and with speed $15 \mathrm{~m} / \mathrm{s}$ for other half of the time. The mean speed of the rider averaged over the whole time of motion is $\frac{x}{7} \mathrm{~m} / \mathrm{s}$. The value of x is
$\qquad$ .

Q4. The general displacement of a simple harmonic oscillator is $x=A \sin \omega t$. Let $T$ be its time period. The slope of its potential energy $(U)-$ time ( $t$ ) curve will be maximum when $t=\frac{T}{\beta}$. The value of $\beta$ is $\qquad$ .

Q5. In Young's double slit experiment, two slits $S_{1}$ and $S_{2}$ are ' $d$ ' distance apart and the separation from slits to screen is D (as shown in figure). Now if two transparent slabs of equal thickenss 0.1 mm but refractive index 1.51 and 1.55 are introduced in the path of beam ( $\lambda=4000 \AA$ ) from $S_{1}$ and $S_{2}$ respectively. The central bright fringe spot will shift by
$\qquad$ number of fringes.


Q6. A point source of light is placed at the centre of curvature of a hemispherical surface. The source emits a power of 24 W . The radius of curvature of hemisphere is 10 cm and the inner surface is completely reflecting. The force on the hemisphere due to the light falling on it is
$\qquad$ $\times 10^{-8} \mathrm{~N}$.

Q7. In an experiment for estimating the value of focal length of converging mirror, Image of an object placed at 40 cm from the pole of the mirror is formed at distance 120 cm from the pole of the mirror. These distances are measured with a modified scale in which there are 20 small divisions in 1 cm . The value of error in measurement of focal length of the mirror is $\frac{1}{\mathrm{k}} \mathrm{cm}$. The value of $K$ is
$\qquad$ -.

Q8. A capacitor of capacitance $900 \mu \mathrm{~F}$ is charged by a 100 V battery. The capacitor is disconnected from the battery and connected to another uncharged identical capacitor such that one plate of uncharged capacitor connected to positive plate and another plate of uncharged capacitor connected to negative plate of the charged capacitor. The loss of energy in this process is measured as $x \times 10^{-2} \mathrm{~J}$. The value of x is $\qquad$ .

Q9. A thin uniform rod of length $2 m$, cross sectional area ' $A$ ' and density ' $d$ ' is rotated about an axis passing through the centre and perpendicular to its length with angular velocity $\omega$. If value of $\omega$ in terms of its rotational kinetic energy E is $\sqrt{\frac{\alpha \mathrm{E}}{\mathrm{Ad}}}$ then value of $\alpha$ is $\qquad$ .

Q10. In the following circuit, the magnitude of current $I_{1}$, is $\qquad$ A.


## PART - B (CHEMISTRY)

## SECTION - A

(One Options Correct Type)
This section contains 20 multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE option is correct.

Q1. What is the correct order of acidity of the protons marked A-D in the given compounds?

(A) $\mathrm{H}_{C}>\mathrm{H}_{D}>\mathrm{H}_{A}>\mathrm{H}_{B}$
(B) $\mathrm{H}_{C}>\mathrm{H}_{\mathrm{A}}>\mathrm{H}_{\mathrm{D}}>\mathrm{H}_{B}$
(C) $\mathrm{H}_{D}>\mathrm{H}_{c}>\mathrm{H}_{\mathrm{B}}>\mathrm{H}_{\mathrm{A}}$
(D) $\mathrm{H}_{C}>\mathrm{H}_{\mathrm{D}}>\mathrm{H}_{B}>\mathrm{H}_{\mathrm{A}}$

Q2. Which of the following is correct order of ligand field strength?
(A) $\mathrm{CO}<$ en $<\mathrm{NH}_{3}<\mathrm{C}_{2} \mathrm{O}_{4}^{2-}<\mathrm{S}^{2-}$
(B) $\mathrm{S}^{2-}<\mathrm{NH}_{3}<\mathrm{en}<\mathrm{CO}<\mathrm{C}_{2} \mathrm{O}_{4}^{2-}$
(C) $\mathrm{S}^{2-}<\mathrm{C}_{2} \mathrm{O}_{4}^{2-}<\mathrm{NH}_{3}<$ en $<\mathrm{CO}$
(D) $\mathrm{NH}_{3}<$ en $<\mathrm{CO}<\mathrm{S}^{2-}<\mathrm{C}_{2} \mathrm{O}_{4}^{2-}$

Q3. In the extraction of copper, its sulphide ore is heated in a reverberatory furnace after mixing with silica to:
(A) remove calcium as $\mathrm{CaSiO}_{3}$
(B) Decrease the temperature needed for roasting of $\mathrm{Cu}_{2} \mathrm{~S}$
(C) Separate CuO as $\mathrm{CuSiO}_{3}$
(D) Remove FeO as $\mathrm{FeSiO}_{3}$

Q4. The major products ' $A$ ' and ' $B$ ', respectively, are
'A' $\leftarrow \frac{\text { Cold }}{\mathrm{H}_{2} \mathrm{SO}_{4}}$

(A)

\&

(B)
 \&

(C)

(D)
 \&


Q5. Benzyl isocyanide can be obtained by:
(A)

(B)

(C)

(D)


Choose the correct answer from the option given below:
(A) only B
(B) B and C
(C) A and B
(D) A and D

Q6. During the qualitative analysis of $\mathrm{SO}_{3}^{2-}$ using dilute $\mathrm{H}_{2} \mathrm{SO}_{4}, \mathrm{SO}_{2}$ gas is evolved which turns $\mathrm{K}_{2} \mathrm{Cr}_{2} \mathrm{O}_{7}$ solution (acidified with dilute $\mathrm{H}_{2} \mathrm{SO}_{4}$ )
(A) Red
(B) Green
(C) Blue
(D) Black

Q7. Lithium aluminium hydride can be prepared from the reaction of
(A) $\mathrm{LiCl}, \mathrm{Al}$ and $\mathrm{H}_{2}$
(B) LiH and $\mathrm{Al}(\mathrm{OH})_{3}$
(C) LiH and $\mathrm{Al}_{2} \mathrm{Cl}_{6}$
(D) LiCl and $\mathrm{Al}_{2} \mathrm{H}_{6}$

Q8. Match List I with List II

| List-I <br> (molecules / ions) |  | List-II <br> (No of lone pairs of e <br> on central atom) |  |
| :--- | :--- | :--- | :--- |
| A. | $\mathrm{IF}_{7}$ | I. | Three |
| B. | $\mathrm{ICI}_{4}^{-}$ | II. | One |
| C. | $\mathrm{XeF}_{6}$ | III. | Two |
| D. | $\mathrm{XeF}_{2}$ | IV. | Zero |

Choose the correct answer from the options given below:
(A) A-IV, B-I, C-II, D- III
(B) A-II, B-III, C-IV, D-I
(C) A-IV, B-III, C-II, D-I
(D) A-II, B-I, C-IV, D-III

Q9. Given below are two statements: one is labelled as Assertion(A) and the other is labelled as Reason (R).
Assertion (A): In expensive scientific instruments, silica gel is kept in watch-glasses or in semipermeable membrane bags.
Reason (R): Silica gel adsorbs moisture from air via adsorption thus protects the instrument from water corrosion (rusting) and / or prevents malfunctioning.
In the light of the above statements, choose the correct answer from the options given below:
(A) (A) is true but (R) is false
(B) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(C) Both (A) and (R) are true and (R) is the correct explanation of (A)
(D) (A) is false but (R) is true

Q10. Match List I with List II

| List-I (atomic number) |  | List-II(block of periodic table) |  |
| :--- | :--- | :--- | :--- |
| A. | 37 | I. | p-block |
| B. | 78 | II. | d-block |
| C. | 52 | III. | f-block |
| D. | 65 | IV. | s-block |

Choose the correct answer from the options given below:
(A) A-I, B-III, C-IV, D- II
(B) A-IV, B-III, C-II, D-I
(C) A-II, B-IV, C-I, D-III
(D) A-IV, B-II, C-I, D-III

Q11. Caprolactam when heated at high temperature in presence of water, gives
(A) Dacron
(B) Nylon 6
(C) Teflon
(D) Nylon 6,6

Q12. The alkaline earth metal sulphate(s) which are readily soluble in water is/ are
(A) $\mathrm{BeSO}_{4}$
(B) $\mathrm{MgSO}_{4}$
(C) $\mathrm{CaSO}_{4}$
(D) $\mathrm{SrSO}_{4}$
(E) $\mathrm{BaSO}_{4}$

Choose the correct answer from the options given below:
(A) B only
(B) B and C
(C) A and B
(D) A only

Q13. Which of the following compounds would give the following set of qualitatiave analysis?
(i) Fehling's Test: Positive
(ii) Na fusion extract upon treatment with sodium nitroprusside gives a blood red colour but not Prussian blue.
(A)

(B)

(C)

(D)


Q14. In the wet tests for identification of various cations by precipitation, which transition element cation doesn't belong to group IV in qualitative inorganic analysis?
(A) $\mathrm{Fe}^{3+}$
(B) $\mathrm{Co}^{2+}$
(C) $\mathrm{Zn}^{2+}$
(D) $\mathrm{Ni}^{2+}$

Q15. To inhibit the growth of tumours, identify the compounds used from the following:
A. EDTA
B. Coordination Compounds of Pt
C. D- Penicillamine
D. Cis- Platin

Choose the correct answer from the option given below :
(A) A and C only
(B) B and D only
(C) C and D only
(D) A and B only

Q16. Formation of photochemical smog involves the following reaction in which $A, B$ and $C$ are respectively.
(i) $\mathrm{NO}_{2} \xrightarrow{\text { hv }} \mathrm{A}+\mathrm{B}$
(ii) $\mathrm{B}+\mathrm{O}_{2} \rightarrow \mathrm{C}$
(iii) $\mathrm{A}+\mathrm{C} \rightarrow \mathrm{NO}_{2}+\mathrm{O}_{2}$

Choose the correct answer from the options given below:
(A) $\mathrm{N}, \mathrm{O}_{2} \& \mathrm{O}_{3}$
(B) $\mathrm{NO}, \mathrm{O} \& \mathrm{O}_{3}$
(C) $\mathrm{O}, \mathrm{NO} \& \mathrm{NO}_{3}^{-}$
(D) $\mathrm{O}, \mathrm{N}_{2} \mathrm{O} \& \mathrm{NO}$

Q17. Amongst the following compounds, which one is an antacid?
(A) Terfenadine
(B) Brompheniramine
(C) Meprobamate
(D) Ranitidine

Q18. Match List I with List II
A.



## List-II

B.

C.

I. Fittig reaction
II. Wurtz Fittig reaction
III. Finkelstein reaction
D. $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{Cl}+\mathrm{NaI} \rightarrow \mathrm{C}_{2} \mathrm{H}_{5} \mathrm{I}+\mathrm{NaCl}$
IV. Sandmeyer reaction

Choose the correct answer from the options given below:
(A) A-II, B-I, C-IV, D- III
(B) A-IV, B-II, C-III, D-I
(C) A-II, B-I, C-III, D-IV
(D) A-III, B-II, C-IV, D-I

Q19. Given below are two statements: one is labelled as Assertion(A) and the other is labelled as Reason (R).
Assertion (A): Ketoses give Seliwanoff's test faster than Aldoses.
Reason (R): Ketoses undergo $\beta$-elimination followed by formation furfural.
In the light of the above statements, choose the correct answer from the options given below:
(A) (A) is true but (R) is false
(B) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(C) (A) is false but (R) is true
(D) Both (A) and (R) are true and (R) is the correct explanation of (A)

Q20. For $\mathrm{OF}_{2}$ molecule consider the following:
A. Number of lone pairs on oxygen is 2 ,
B. FOF angle is less than $104.5^{\circ}$.
C. Oxidation state of O is -2 .
D. Molecule is bent ' $V$ ' shaped.
D. Molecular geometry is linear.

Correct options are:
(A) A, C, D only
(B) A, B, D only
(C) B, E, A only
(D) C, D, E only

## SECTION - B

## (Numerical Answer Type)

This section contains 10 Numerical based questions. The answer to each question is rounded off to the nearest integer value.

Q1. When 2 litre of ideal gas expands isothermally into vacuum to a total volume of 6 litre, the change in internal energy is $\qquad$ J. (Nearest integer)

Q2. The number of electrons involved in the reduction of permagnate to manganese dioxide in acidic medium is $\qquad$ .

Q3. A solution containing 2 g of a non- volatile solute in 20 g of water boils at 373.52 K . The molecular mass of the solute is $\qquad$ $\mathrm{g} \mathrm{mol}^{-1}$.(Nearest integer) Given, water boils at $373 \mathrm{~K}, \mathrm{~Kb}$ for water $=0.52 \mathrm{~K} \mathrm{~kg} \mathrm{~mol}^{-1}$

Q4. Consider the cell
$\mathrm{Pt}_{(\mathrm{s})}\left|\mathrm{H}_{2}(\mathrm{~g}, 1 \mathrm{~atm})\right| \mathrm{H}^{+}(\mathrm{aq} .1 \mathrm{M})\left\|\mathrm{Fe}_{\text {(aq) }}^{3+}, \mathrm{Fe}_{(\text {(aq) }}^{2+}\right\| \mathrm{Pt}_{(\mathrm{s})}$
When the potential of the cell is 0.712 V at 298 K , the ratio $\left[\mathrm{Fe}^{2+}\right] /\left[\mathrm{Fe}^{3+}\right]$ is $\qquad$ .
(Nearest integer)
Given: $\mathrm{Fe}^{3+}+\mathrm{e}^{-}=\mathrm{Fe}^{2+}, \mathrm{E}^{0} \mathrm{Fe}^{3+}, \mathrm{Fe}^{2+} \mid \mathrm{Pt}=0.771$
$\frac{2.303 R T}{F}=0.06 \mathrm{~V}$
Q5. If compound $A$ reacts with $B$ following first order kinetics with rate constant $2.011 \times 10^{-3} \mathrm{~s}^{-1}$. The time taken by A (in seconds) to reduce from 7 g to 2 g will be $\qquad$ -.
(Nearest integer)
$[\log 5=0.698, \log 7=845, \log 2=0.301]$
Q6. Some amount of dichloromethane $\left(\mathrm{CH}_{2} \mathrm{Cl}_{2}\right)$ is added to 671.141 mL of chloroform $\left(\mathrm{CHCl}_{3}\right)$ to prepare $2.6 \times 10^{-3} \mathrm{M}$ solution of $\mathrm{CH}_{2} \mathrm{Cl}_{2}(\mathrm{DCM})$. The concentration of DCM is $\qquad$ ppm (by mass)
Given:
Atomic mass : C=12
$\mathrm{H}=1$
$\mathrm{Cl}=35.5$
Density of $\mathrm{CHCl}_{3}=1.49 \mathrm{~g} \mathrm{~cm}^{-3}$
Q7. A trisubstituted compound ' A ' $\mathrm{C}_{10} \mathrm{H}_{12} \mathrm{O}_{2}$ gives neutral $\mathrm{FeCl}_{3}$ test positive. Treatment of compound ' A ' with NaOH and $\mathrm{CH}_{3} \mathrm{Br}$ gives $\mathrm{C}_{11} \mathrm{H}_{14} \mathrm{O}_{2}$, with hydroidic acid gives methyl iodide and with hot conc. NaOH gives a compound $\mathrm{BC}_{10} \mathrm{H}_{12} \mathrm{O}_{2}$. Compound ' $A$ ' also decolorizes alkaline $\mathrm{KMnO}_{4}$. The number of $\pi$ bond/s present in the compound ' $A$ ' is $\qquad$ .

Q8. The energy of one mole of photons of radiation of frequency $2 \times 10^{12} \mathrm{~Hz} \mathrm{in}^{\mathrm{J} \mathrm{mol}}{ }^{-1}$ is $\qquad$ (Nearest integer)
[Given ; $h=6.626 \times 10^{-34} \mathrm{Js} N_{A}=6.022 \times 10^{23} \mathrm{~mol}^{-1}$ ]
Q9. A 300 mL bottle of soft drink has $0.2 \mathrm{M} \mathrm{CO}_{2}$ dissolved in it. Assuming $\mathrm{CO}_{2}$ behaves as an ideal gas, the volume of the dissolved $\mathrm{CO}_{2}$ at STP is $\qquad$ mL (Nearest integer)
Given: At STP molar volume of an ideal gas is $\overline{22.7 \mathrm{~L} \mathrm{~mol}^{-1}}$

Q10. 600 mL of 0.01 M HCl is mixed with 400 mL of $0.01 \mathrm{M} \mathrm{H}_{2} \mathrm{SO}_{4}$. The pH of the mixture is $\qquad$ $\times 10^{-2 .}$ (Nearest integer)
[Given $\log 2=0.30$

$$
\log 3=0.48
$$

$$
\log 5=0.69
$$

$$
\log 7=0.84
$$

$$
\log 11=1.04]
$$

## PART - C (MATHEMATICS)

## SECTION - A

(One Options Correct Type)
This section contains 20 multiple choice questions. Each question has four choices (A), (B), (C) and (D), out of which ONLY ONE option is correct.

Q1. If an unbiased die, marked with $-2,-1,0,1,2,3$ on its faces, is thrown five times, then the probability that the product of the outcomes is positive, is :
(A) $\frac{881}{2592}$
(B) $\frac{27}{288}$
(C) $\frac{521}{2592}$
(D) $\frac{440}{2592}$

Q2. The minimum number of elements that must be added to the relation $R=\{(a, b),(b, c)\}$ on the set $\{\mathrm{a}, \mathrm{b}, \mathrm{c}\}$ so that it becomes symmetric and transitive is :
(A) 4
(B) 5
(C) 7
(D) 3

Q3. Let a unit vector $\widehat{\mathrm{OP}}$ make angles $\alpha, \beta, \gamma$ with the positive directions of the co-ordinate axes OX , $\mathrm{OY}, \mathrm{OZ}$ respectively, where $\beta \in\left(0, \frac{\pi}{2}\right)$. If $\widehat{\mathrm{OP}}$ is perpendicular to the plane through points $(1,2,3),(2,3,4)$ and $(1,5,7)$, then which one of the following is true?
(A) $\alpha \in\left(\frac{\pi}{2}, \pi\right)$ and $\gamma \in\left(\frac{\pi}{2}, \pi\right)$
(B) $\alpha \in\left(0, \frac{\pi}{2}\right)$ and $\gamma \in\left(\frac{\pi}{2}, \pi\right)$
(C) $\alpha \in\left(\frac{\pi}{2}, \pi\right)$ and $\gamma \in\left(0, \frac{\pi}{2}\right)$
(D) $\alpha \in\left(0, \frac{\pi}{2}\right)$ and $\gamma \in\left(0, \frac{\pi}{2}\right)$

Q4. If $\tan 15^{\circ}+\frac{1}{\tan 75^{\circ}}+\frac{1}{\tan 105^{\circ}}+\tan 195^{\circ}=2 \mathrm{a}$, then the value of $\left(\mathrm{a}+\frac{1}{\mathrm{a}}\right)$ is :
(A) 2
(B) $4-2 \sqrt{3}$
(C) $5-\frac{3}{2} \sqrt{3}$
(D) 4

Q5. Let the solution curve $y=y(x)$ of the differential equation $\frac{d y}{d x}-\frac{3 x^{5} \tan ^{-1}\left(x^{3}\right)}{\left(1+x^{6}\right)^{3 / 2}} y=2 x$ exp. $\left\{\frac{x^{3}-\tan ^{-1} x^{3}}{\sqrt{\left(1+x^{6}\right)}}\right\}$ pass through the origin. Then $y(1)$ is equal to :
(A) $\exp \left(\frac{1-\pi}{4 \sqrt{2}}\right)$
(B) $\exp \left(\frac{\pi-4}{4 \sqrt{2}}\right)$
(C) $\exp \left(\frac{4-\pi}{4 \sqrt{2}}\right)$
(D) $\exp \left(\frac{4+\pi}{4 \sqrt{2}}\right)$

Q6. Let the system of linear equations
$\mathrm{x}+\mathrm{y}+\mathrm{kz}=2$
$2 x+3 y-z=1$
$3 x+4 y+2 z=k$
have infinitely many solutions. Then the system
$(k+1) x+(2 k-1) y=7$
$(2 k+1) x+(k+5) y=10$
has :
(A) unique solution satisfying $x-y=1$
(B) unique solution satisfying $x+y=1$
(C) no solution
(D) infinitely many solutions

Q7. If $\vec{a}, \vec{b}, \vec{c}$ are three non-zero vectors and $\hat{n}$ is a unit vector perpendicular to $\vec{c}$ such that $\vec{a}=\alpha \vec{b}-\hat{n},(\alpha \neq 0)$ and $\vec{b} \cdot \vec{c}=12$, then $|\vec{c} \times(\vec{a} \times \vec{b})|$ is equal to:
(A) 9
(B) 12
(C) 6
(D) 15

Q8. Let $y=x+2,4 y=3 x+6$ and $3 y=4 x+1$ be three tangent lines to the circle $(x-h)^{2}+(y-k)^{2}=r^{2}$. Then $h+k$ is equal to :
(A) 6
(B) $5 \sqrt{2}$
(C) $5(1+\sqrt{2})$
(D) 5

Q9. If the coefficient of $x^{15}$ in the expansion of $\left(a x^{3}+\frac{1}{b x^{1 / 3}}\right)^{15}$ is equal to the coefficient of $x^{-15}$ in the expansion of $\left(a x^{1 / 3}-\frac{1}{b x^{3}}\right)^{15}$, where $a$ and $b$ are positive real numbers, then for each such ordered pair ( $\mathrm{a}, \mathrm{b}$ ):
(A) $a=b$
(B) $a=3 b$
(C) $a b=3$
(D) $a b=1$

Q10. If $a_{n}=\frac{-2}{4 n^{2}-16 n+15}$, then $a_{1}+a_{2}+\ldots .+a_{25}$ is equal to :
(A) $\frac{49}{138}$
(B) $\frac{50}{141}$
(C) $\frac{52}{147}$
(D) $\frac{51}{144}$

Q11. Among the statements :
$(S 1)((p \vee q) \Rightarrow r) \Leftrightarrow(p \Rightarrow r)$
$(S 2)((p \vee q) \Rightarrow r) \Leftrightarrow((p \Rightarrow r) \vee(q \Rightarrow r))$
(A) neither (S1) nor (S2) is a tautology
(B) only (S2) is a tautology
(C) both (S1) and (S2) are tautologies
(D) only (S1) is a tautology

Q12. If $P(h, k)$ be a point on the parabola $x=4 y^{2}$, which is nearest to the point $Q(0,33)$, then the distance of $P$ from the directrix of the parabola $y^{2}=4(x+y)$ is equal to :
(A) 8
(B) 4
(C) 2
(D) 6

Q13. If $[t]$ denotes the greatest integer $\leq t$, then the value of $\frac{3(e-1)}{e} \int_{1}^{2} x^{2} e^{[x]\left[\left[x^{3}\right]\right.} d x$ is :
(A) $e^{8}-e$
(B) $\mathrm{e}^{8}-1$
(C) $e^{7}-1$
(D) $e^{9}-e$

Q14. The number of points on the curve $y=54 x^{5}-135 x^{4}-70 x^{3}+180 x^{2}+210 x$ at which the normal lines are parallel to $x+90 y+2=0$ is :
(A) 3
(B) 2
(C) 0
(D) 4

Q15. The line $\ell_{1}$ passes through the point $(2,6,2)$ and is perpendicular to the plane $2 x+y-2 z=10$. Then the shortest distance between the line $\ell_{1}$ and the line $\frac{x+1}{2}=\frac{y+4}{-3}=\frac{z}{2}$ is :
(A) $\frac{19}{3}$
(B) 7
(C) 9
(D) $\frac{13}{3}$

Q16. The coefficient of $x^{301}$ in $(1+x)^{500}+x(1+x)^{499}+x^{2}(1+x)^{498}+\ldots .+x^{500}$ is :
(A) ${ }^{500} \mathrm{C}_{301}$
(B) ${ }^{501} \mathrm{C}_{302}$
(C) ${ }^{500} \mathrm{C}_{300}$
(D) ${ }^{501} \mathrm{C}_{200}$

Q17. Suppose $f: R \rightarrow(0, \infty)$ be a differentiable function such that $5 f(x+y)=f(x) \cdot f(y), \forall x, y \in R$. If $f(3)=320$, then $\sum_{n=0}^{5} f(n)$ is equal to :
(A) 6825
(B) 6525
(C) 6875
(D) 6575

Q18. If the solution of the equation $\log _{\cos x} \cot x+4 \log _{\sin x} \tan x=1, x \in\left(0, \frac{\pi}{2}\right)$, is $\sin ^{-1}\left(\frac{\alpha+\sqrt{\beta}}{2}\right)$, where $\alpha, \beta$ are integers, then $\alpha+\beta$ is equal to :
(A) 4
(B) 3
(C) 6
(D) 5

Q19. Let $A=\left(\begin{array}{ll}m & n \\ p & q\end{array}\right), d=|A| \neq 0$ and $|A-d(\operatorname{Adj} A)|=0$. Then
(A) $1+d^{2}=m^{2}+q^{2}$
(B) $1+d^{2}=(m+q)^{2}$
(C) $(1+d)^{2}=m^{2}+q^{2}$
(D) $(1+\mathrm{d})^{2}=(\mathrm{m}+\mathrm{q})^{2}$

Q20. A straight line cuts off the intercepts $O A=a$ and $O B=b$ on the positive directions of $x$-axis and $y$-axis respectively. If the perpendicular from origin $O$ to this line makes an angle of $\frac{\pi}{6}$ with positive direction of $y$-axis and the area of $\triangle \mathrm{OAB}$ is $\frac{98}{3} \sqrt{3}$, then $\mathrm{a}^{2}-\mathrm{b}^{2}$ is equal to :
(A) 196
(B) $\frac{392}{3}$
(C) $\frac{196}{3}$
(D) 98

## SECTION - B

## (Numerical Answer Type)

This section contains 10 Numerical based questions. The answer to each question is rounded off to the nearest integer value.

Q1. Number of 4-digit numbers (the repeation of digits is allowed) which are made using the digits 1 , 2,3 and 5 and are divisible by 15 , is equal to $\qquad$
Q2. The mean and variance of 7 observations are 8 and 16 respectively. If one observation 14 is omitted and $a$ and $b$ are respectively mean and variance of remaining 6 observation, then $a+3 b-5$ is equal to. $\qquad$

Q3. If the equation of the plane passing through the point $(1,1,2)$ and perpendicular to the line $x-3 y+2 z-1=0=4 x-y+z$ is $A x+B y+C z=1$, then $140(C-B+A)$ is equal to........

Q4. Let $f^{1}(x)=\frac{3 x+2}{2 x+3}, x \in R-\left\{\frac{-3}{2}\right\}$
For $n \geq 2$, define $f^{n}(x)=f^{1} o f^{n-1}(x)$.
If $f^{5}(x)=\frac{a x+b}{b x+a}, \operatorname{gcd}(a, b)=1$, then $a+b$ is equal to....

Q5. Let $\sum_{n=0}^{\infty} \frac{n^{3}((2 n)!)+(2 n-1)(n!)}{(n!)((2 n)!)}=a e+\frac{b}{e}+c$, where $a, b, c \in Z$ and $e=\sum_{n=0}^{\infty} \frac{1}{n!}$. Then $a^{2}-b+c$ is equal to......

Q6. Let $\alpha$ be the area of the larger region bounded by the curve $y^{2}=8 x$ and the lines $y=x$ and $x=$ 2 , which lies in the first quadrant. Then the value of $3 \alpha$ is equal to. $\qquad$

Q7. Let $z=1+i$ and $z_{1}=\frac{1+i \bar{z}}{\bar{z}(1-z)+\frac{1}{z}}$. Then $\frac{12}{\pi} \arg \left(z_{1}\right)$ is equal to.......

Q8. If $\lambda_{1}<\lambda_{2}$ are two values of $\lambda$ such that the angle between the planes $P_{1}: \vec{r} \cdot(3 \hat{i}-5 \hat{j}+\hat{k})=7$ and $P_{2}: \vec{r} \cdot(\lambda \hat{i}+\hat{j}-3 \hat{k})=9$ is $\sin ^{-1}\left(\frac{2 \sqrt{6}}{5}\right)$, then the square of the length of perpendicular from the point $\left(38 \lambda_{1}, 10 \lambda_{2}, 2\right)$ to the plane $P_{1}$ is.......

Q9. Let $S=\{1,2,3,4,5,6\}$. Then the number of one-one functions $f: S \rightarrow P(S)$, where $P(S)$ denote the power set of $S$, such that $f(n) \subset f(m)$ where $n<m$ is.......

Q10. $\lim _{x \rightarrow 0} \frac{48}{x^{4}} \int_{0}^{x} \frac{t^{3}}{t^{6}+1} d t$ is equal to......

## Keys to JEE Main 2024 Mock Test 4

## PART - A (PHYSICS)

## SECTION - A

| 1. | C | 2. | B | 3. | B | 4. | D |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5. | A | 6. | C | 7. | C | 8. | A |
| 9. | A | 10. | D | 11. | D | 12. | B |
| 13. | C | 14. | A | 15. | D | 16. | C |
| 17. | C | 18. | D | 19. | D | 20. | B |
|  | SECTION - B |  |  |  |  |  |  |
| 1. | 30 | 2. | 220 | 3. | 50 | 4. | 8 |
| 5. | 10 | 6. | 4 | 7. | 32 | 8. | 225 |
| 9. | 3 | 10. | 2 |  |  |  |  |

## PART - B (CHEMISTRY) SECTION - A

| 1. | A | 2. | C | 3. | D | 4. | A |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 5. | C | 6. | B | 7. | C | 8. | C |
| 9. | C | 10. | D | 11. | B | 12. | C |
| 13. | B | 14. | A | 15. | B | 16. | B |
| 17. | D | 18 | A | 19. | A | 20. | B |

## SECTION - B

| 1. | 0 | 2. | 3 | 3. | 100 | 4. | 10 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 5. | 623 | 6. | 221 | 7. | 4 | 8. | 798 |
| 9. | 1362 | 10. | 186 |  |  |  |  |

## PART - C (MATHEMATICS) <br> SECTION - A

| 1. | C | 2. | C | 3. | A | 4. | D |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 5. | C | 6. | B | 7. | B | 8. | D |
| 9. | D | 10. | B | 11. | A | 12. | D |
| 13. | A | 14. | D | 15. | C | 16. | D |
| 17. | A | 18 | A | 19. | D | 20. | B |

## SECTION - B

| 1. | 21 | 2. | 37 | 3. | 15 | 4. | 3125 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 5. | 26 | 6. | 22 | 7. | 9 | 8. | 315 |
| 9. | 3240 | 10. | 12 |  |  |  |  |

